WHAT IS CLAIMED IS:-

1. A color conversion device for performing pixel-by-pixel color conversion from a first set of three color data representing red, green and blue, or cyan, magenta and yellow, into a second set of three color data representing red, green and blue, or cyan, magenta, and yellow, said device comprising:

first calculation means for calculating a minimum value α and a maximum value β of said first set of three color data for each pixel;

hue data calculating means for calculating hue data r, g, b, y, m and c based on said first set of three color data, and said minimum and maximum values α and β outputted from said calculating means;

means for generating first comparison-result data based on the hue data outputted from said hue data calculating means;

means for generating second comparison-result data based on said first comparison-result data;

second calculation means for performing calculation using the hue data outputted from said hue data calculating means to produce calculation result data;

coefficient generating means for generating specified matrix coefficients for the hue data, the calculation result data, the first comparison-result data and the second comparison-result data;

third calculation means responsive to said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, and the coefficients from said coefficient generating means for calculating a third set of three color data representing red, green and blue, or cyan, magenta, and yellow, said third calculation means performing calculation including

matrix calculation performed at least on said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, and the coefficients from said coefficient generating means; and

gray scale conversion means for converting the gray scale of said third set of three color data, to produce said second set of three color data.

2. The color conversion device according to claim 1, wherein said third calculation means performs said matrix calculation on said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, and the coefficients from said coefficient generating means, and further includes synthesizing means for adding said minimum value α from said first calculation means to the results of said matrix calculation.

3. The color conversion device according to claim 2, wherein

said coefficient generating means generates predetermined matrix coefficients Eij (i = 1 to 3, j = 1 to 3), and Fij (i = 1 to 3, j = 1 to 18), and

said third calculation means performs the calculation using the hue data, said said first comparison-result data, said second comparison-result data, said calculation result data, said minimum value α from said calculating means, and said matrix coefficients to determine the third set of three color data representing red, green and blue, denoted by Ro, Go and Bo, in accordance with the following formula (1):

$$\begin{bmatrix} Ro \\ Go \\ Bo \end{bmatrix} = (Eij) \begin{bmatrix} r \\ g \\ b \end{bmatrix} + (Fij) \begin{bmatrix} c*m \\ m*y \\ y*c \\ r*g \\ g*b \\ b*r \\ h1r \\ h1g \\ h1b \\ h1c \\ h1m \\ h1y \\ h2ry \\ h2rm \\ h2gy \\ h2gc \\ h2bm \\ h2bc \end{bmatrix} + \begin{bmatrix} \alpha \\ \alpha \\ \alpha \end{bmatrix} \quad \ldots(1)$$

wherein h1r, h1g, h1b, h1c, h1m and h1y denote said first comparison-result data, and h2ry, h2rm, h2gy, h2gc, h2bm and h2bc denote said second comparison result data.

4. The color conversion device according to claim 2, wherein

said coefficient generating means generates predetermined matrix coefficients Eij (i = 1 to 3, j = 1 to 3), and Fij (i = 1 to 3, j = 1 to 18), and

said third calculation means performs the calculation using the hue data, said said first comparison-result data, said second comparison-result data, said calculation result data, said minimum value α from said calculating means, and said matrix coefficients to determine the third set of three color data representing cyan, magenta and yellow denoted by Co, Mo and Yo, in accordance with the following formula (2):

$$\begin{bmatrix} Co \\ Mo \\ Yo \end{bmatrix} = (Eij) \begin{bmatrix} c \\ m \\ y \end{bmatrix} + (Fij) \begin{bmatrix} c*m \\ m*y \\ y*c \\ r*g \\ g*b \\ b*r \\ h1r \\ h1g \\ h1b \\ h1c \\ h1m \\ h1y \\ h2ry \\ h2rm \\ h2gy \\ h2gc \\ h2bm \\ h2bc \end{bmatrix} + \begin{bmatrix} \alpha \\ \alpha \\ \alpha \end{bmatrix} \quad \ldots(2)$$

wherein h1r, h1g, h1b, h1c, h1m and h1y denote said first comparison-result data, and h2ry, h2rm, h2gy, h2gc, h2bm and h2bc denote said second comparison result data.

5. The color conversion device according to claim 1, wherein said third calculation means performs said matrix calculation on said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, the coefficients from said coefficient generating means, and said minimum value α from said first calculation means.

6. The color conversion device according to claim 5, wherein

said coefficient generating means generates predetermined matrix coefficients Eij (i = 1 to 3, j = 1 to 3), and Fij (i = 1 to 3, j = 1 to 19), and

said third calculation means performs the calculation using the hue data, said said first comparison-result data, said second comparison-result data, said calculation result

data, said minimum value α from said calculating means, and said matrix coefficients to determine the third set of three color data representing red, green and blue, denoted by Ro, Go and Bo, in accordance with the following formula (3):

$$\begin{bmatrix} Ro \\ Go \\ Bo \end{bmatrix} = (Eij) \begin{bmatrix} r \\ g \\ b \end{bmatrix} + (Fij) \begin{bmatrix} c*m \\ m*y \\ y*c \\ r*g \\ g*b \\ b*r \\ h1r \\ h1g \\ h1b \\ h1c \\ h1m \\ h1y \\ h2ry \\ h2rm \\ h2gy \\ h2gc \\ h2bm \\ h2bc \\ \alpha \end{bmatrix} \quad \ldots(3)$$

wherein h1r, h1g, h1b, h1c, h1m and h1y denote said first comparison-result data, and h2ry, h2rm, h2gy, h2gc, h2bm and h2bc denote said second comparison result data.

7. The color conversion device according to claim 5, wherein

said coefficient generating means generates predetermined matrix coefficients Eij (i = 1 to 3, j = 1 to 3), and Fij (i = 1 to 3, j = 1 to 19), and

said third calculation means performs the calculation using the hue data, said said first comparison-result data, said second comparison-result data, said calculation result data, said minimum value α from said calculating means, and said matrix coefficients to determine the third set of three color data representing cyan, magenta and yellow denoted by

Co, Mo and Yo, in accordance with the following formula (4):

$$\begin{bmatrix} Co \\ Mo \\ Yo \end{bmatrix} = (Eij) \begin{bmatrix} c \\ m \\ y \end{bmatrix} + (Fij) \begin{bmatrix} c*m \\ m*y \\ y*c \\ r*g \\ g*b \\ b*r \\ h1r \\ h1g \\ h1b \\ h1c \\ h1m \\ h1y \\ h2ry \\ h2rm \\ h2gy \\ h2gc \\ h2bm \\ h2bc \\ \alpha \end{bmatrix} \quad \ldots(4)$$

wherein h1r, h1g, h1b, h1c, h1m and h1y denote said first comparison-result data, and h2ry, h2rm, h2gy, h2gc, h2bm and h2bc denote said second comparison result data.

8. The color conversion device according to claim 1, wherein

said first set of three color data represent red, green and blue,

said third set of three color data represent red, green and blue, and

said hue data calculation means calculates the hue data r, g, b, y, m, c by subtraction in accordance with:

$r = Ri - \alpha$,

$g = Gi - \alpha$,

$b = Bi - \alpha$,

$y = \beta - Bi$,

$m = \beta - Gi$, and

$c = \beta - Ri$,

wherein Ri, Gi and Bi represent said first set of three color data.

9. The color conversion device according to claim 1, wherein

said first set of three color data represent cyan, magenta and yellow,

said third set of three color data represent red, green and blue,

said device further comprises means for determining complement of said first set of three color data, and

said hue data calculation means calculates the hue data r, g, b, y, m, c by subtraction in accordance with:

$r = Ri - \alpha$,

$g = Gi - \alpha$,

$b = Bi - \alpha$,

$y = \beta - Bi$,

$m = \beta - Gi$, and

$c = \beta - Ri$,

wherein Ri, Gi and Bi represent data produced by the determination of the complement of said first set of three color data.

10. The color conversion device according to claim 1, wherein

said first set of three color data represent cyan, magenta and yellow,

said third set of three color data represent cyan, magenta and yellow, and

said hue data calculation means calculates the hue data r, g, b, y, m, c by subtraction in accordance with:

$r = \beta - Ci$,

$g = \beta - Mi$,

$b = \beta - Yi$,

y = Yi - α ,
m = Mi - α , and
c = Ci - α ,
wherein Ci, Mi and Yi represent said first set of three color data.

11. The color conversion device according to claim 1, wherein

said first set of three color data represent red, green and blue,

said third set of three color data represent cyan, magenta and yellow,

said device further comprises means for determining complement of said first set of three color data, and

said hue data calculation means calculates the hue data r, g, b, y, m, c by subtraction in accordance with:

r = β - Ci,
g = β - Mi,
b = β - Yi,
y = Yi - α ,
m = Mi - α , and
c = Ci - α ,
wherein Ci, Mi and Yi represent data produced by the determination of the complement of said first set of three color data.

12. The color conversion device according to claim 1, wherein

said first comparison-result data generating means determines the comparison-result data among the hue data r, g and b, and the comparison-result data among the hue data y, m and c, and

said second comparison-result data generating means comprises multiplying means for multiplying the first

comparison-result data outputted from said first comparison-result data generating means with specific calculation coefficients, and means for determining the comparison-result data based on the outputs of said multiplication means.

13. The color conversion device according to claim 12, wherein

said first comparison-result data generating means determines the first comparison-result data:

h1r = min (m, y),
h1g = min (y, c),
h1b = min (c, m),
h1c = min (g, b),
h1m = min (b, r), and
h1y = min (r, g),

(with min (A, B) representing the minimum value of A and B),

said second comparison-result data generating means determines the second comparison-result data:

h2ry = min (aq1*h1y, ap1*h1r),
h2rm = min (aq2*h1m, ap2*h1r),
h2gy = min (aq3*h1y, ap3*h1g),
h2gc = min (aq4*h1c, ap4*h1g),
h2bm = min (aq5*h1m, ap5*h1b), and
h2bc = min (aq6*h1c, ap6*h1m).

14. The color conversion device according to claim 12, wherein

said multiplying means in said second comparison-result data generating means performs calculation on said first comparison result-data and said calculation coefficients by setting said calculation coefficients aq1 to aq6 and ap1 to ap6 to integral values of 2^n, with n being an integer, and by bit shifting.

15. The color conversion device according to claim 1, wherein said second calculation means determines products of the hue data.

16. The color conversion device according to claim 1, wherein each of said first comparison-result data is determined from two of the hue data and is effective for only one of the six hues of red, green, blue, cyan, magenta and yellow.

17. The color conversion device according to claim 1, wherein each of said second comparison-result data is determined from two of the first comparison-result data and is effective for only one of the six inter-hue areas of red-yellow, yellow-green, green-cyan, cyan-blue, blue-magenta, and magenta-red.

18. The color conversion device according to claim 1, wherein

said coefficient generating means generates specified matrix coefficients Eij (i = 1 to 3, j = 1 to 3) based on a formula (5) below:

$$(Eij)=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix} \qquad \ldots(5)$$

and generates the matrix coefficients Fij (i = 1 to 3, j = 1 to 18, or j = 1 to 19) such that, of the coefficients Fij, the coefficients for said calculation result data are set to zero, and other coefficients are set to specified values.

19. The color conversion device according to claim 1, wherein

said first calculation means calculates a maximum value β and a minimum value α using said first set of three color data, and generates an identification code indicating the hue data which is of a value zero, and

said second calculation means performs arithmetic operation on said hue data based on the identification code outputted from said first calculation means,

said coefficient generating means generates said matrix coefficients based on the identification code outputted from said first calculation means, and

said third calculation means performs matrix calculation using the coefficient from said coefficient generating means to produce said third set of three color data based on the identification code outputted from said first calculation means.

20. A color conversion method of performing pixel-by-pixel color conversion from a first set of three color data representing red, green and blue, or cyan, magenta and yellow, into a second set of three color data representing red, green and blue, or cyan, magenta, and yellow, said method comprising the steps of:

(a) calculating a minimum value α and a maximum value β of said first set of three color data for each pixel;

(b) calculating hue data r, g, b, y, m and c based on said first set of three color data, and said minimum and maximum values α and β obtained at said step (a);

(c) generating first comparison-result data based on the hue data obtained at said step (b);

(d) generating second comparison-result data based on said first comparison-result data;

(e) performing calculation using the hue data obtained at said step (b) to produce calculation result data;

(f) generating specified matrix coefficients for the

hue data, the calculation result data, the first comparison-result data and the second comparison-result data; and

(g) calculating, responsive to said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, and the coefficients generated at said step (f), a third set of three color data representing red, green and blue, or cyan, magenta and yellow; and

(h) converting the gray scale of said third set of three color data, to produce said second set of three colors;

said step (g) comprising the step of performing matrix calculation on at least said hue data, said first comparison-result data, said second comparison-result data, said calculation result data, and the coefficients obtained at said step (f).